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For: METHOD OF MANAGING UPLINK RADIO RESOURCES IN CDMA TELECOMMUNICATIONS SYSTEM, AND ARRANGEMENT THEREFORE

CLAIM FOR PRIORITY UNDER 35 USC § 119

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

January 13, 2004

Sir:

The benefit of the filing date of the following prior foreign application filed in the following foreign country is hereby requested for the above-identified patent application and the priority provided in 35 U.S.C. §119 is hereby claimed:

Finnish Patent Application No. 20030892 filed on June 13, 2003 in Finland

In support of this claim, certified copy of said original foreign application is filed herewith.

It is requested that the file of this application be marked to indicate that the requirements of 35 U.S.C. §119 have been fulfilled and that the Patent and Trademark Office kindly acknowledge receipt of this document.

Please charge any fee deficiency or credit any overpayment with respect to this paper to Counsel's Deposit Account No. 50-2222.

Respectfully submitted,

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Enclosure: Priority Document (1)

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E T U O I K E U S T O D I S T U S
P R I O R I T Y   D O C U M E N T

Hakija Applicant	**Nokia Corporation** **Helsinki**
Patenttihakemus nro Patent application no	**20030892**
Tekemispäivä Filing date	**13.06.2003**
Kansainvälinen luokka International class	**H04B**
Keksinnön nimitys Title of invention	

"Method of managing uplinki radio resources in CDMA telecommunications system, and arrangement"
(Menetelmä nousevan siirtotien radioresurssien hallinnoimiseksi CDMA televiestinjärjestelmässä, ja järjestely)

Täten todistetaan, että oheiset asiakirjat ovat tarkkoja jäljennöksiä Patentti- ja rekisterihallitukselle alkuaan annetuista selityksestä, patenttivaatimuksista, tiivistelmästä ja piirustuksista.

This is to certify that the annexed documents are true copies of the description, claims, abstract and drawings originally filed with the Finnish Patent Office.

Marketta Tehikoski

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Apulaistarkastaja

Maksu 50 €
Fee 50 EUR

Maksu perustuu kauppa- ja teollisuusministeriön antamaan asetukseen 1027/2001 Patentti- ja rekisterihallituksen maksullisista suoritteista muutoksineen.

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Method of managing uplink radio r sources in CDMA tel - communications system, and arrangement

Field

The invention relates to a method of managing uplink radio resources in a CDMA telecommunications system, and an arrangement.

Background

A common approach to manage radio resources in CDMA (Code Division Multiple Access) telecommunications systems is to base managing decisions upon an interference level experienced by a base transceiver station. The interference level is a measurable quantity and may be linked to cell characteristics, such as cell load and capacity, explicitly by using a characterising curve, which characterises the relationship between the interference level and the cell characteristic. For example, in the case of the uplink, the characterising curve is a load curve characterising the relationship between the uplink load and the uplink interference level.

Predictability of the interference level in terms of a change in cell characteristics plays an important role in managing radio resources in telecommunications systems. It is customary to determine an interference level experienced by a base transceiver station by means of a measurement, determine a value of the cell characteristic corresponding to the determined interference level, and predict the change in the interference level that would be generated if the cell characteristic were changed. The validity of the resulting decisions made in the radio resource management depends upon the accuracy of the interference level determination and the predicted change in the interference level.

Predicting changes in the interference level is typically based on knowledge on the characterising curve. The characterising curve assumes a coupling between the overlapping cells. The coupling accounts for the dynamic effect on the interference level due to a series of power adjustment steps in a plurality of user equipment, which effect would arise if the transmit power of an individual user equipment were changed.

However, a coupling assumption may break down in some circumstances, and the correspondence between the characteristic curve and the actual relationship between the interference level and the cell characteristic

fails. A failure in the correspondence leads to inaccuracy in the interference level prediction, thus resulting in an erroneous radio resource management.

Brief description of the invention

An object of the invention is to provide an improved method and an arrangement of managing uplink radio resources. According to an aspect of the invention, there is provided a method of managing uplink radio resources in a CDMA telecommunications system comprising a primary base transceiver station for providing a primary cell and at least one secondary base transceiver station for providing at least one secondary cell, the method comprising: determining an interference level into the primary base transceiver station; determining a contribution of secondary cell connections to the interference level; computing a proportionality factor for adjusting a reference interference level relative to the interference level, the proportionality factor being proportional to the contribution of the secondary cell connections to the interference level; and adjusting the reference interference level relative to the interference level by using the proportionality factor.

According to another aspect of the invention, there is provided an arrangement for managing uplink radio resources in a CDMA telecommunications system comprising a primary base transceiver station for providing a primary cell and at least one secondary base transceiver station for providing at least one secondary cell, the arrangement comprising:

means for determining an interference level into the primary base transceiver station; means for determining a contribution of secondary cell connections to the interference level; means for computing a proportionality factor for adjusting a reference interference level relative to the interference level, the proportionality factor being proportional to the contribution of the secondary cell connections to the interference level; and means for adjusting the reference interference level relative to the interference level by using the proportionality factor. Preferred embodiments of the invention are described in the dependent claims.

The method and arrangement of the invention provide several advantages. In a preferred embodiment of the invention, an uplink radio resource management accounts for a partial coupling between the cells, thus resulting in accuracy in the radio resource control.

List of drawings

In the following, the invention will be described in greater detail with reference to the preferred embodiments and the accompanying drawings, in which

Figure 1 shows an example of the structure of a CDMA telecommunications system;

Figure 2 illustrates effects of cell coupling schemes on power adjustment of user equipment;

Figure 3 illustrates interference level and reference interference level;

Figure 4 shows an arrangement according to embodiments of the invention; and

Figure 5 shows an example of the methodology used by the arrangement according to embodiments of the invention.

Description of embodiments

Figure 1 illustrates an example of a simplified structure of a CDMA (Code Division Multiple Access) telecommunications system to which the invention may be applied.

The CDMA telecommunications system may be based on, for example, WCDMA (Wideband Code Division Multiple Access) technology utilized in third generation cellular telecommunications systems. The structure and function of WCDMA telecommunications systems are known to a person skilled in the art, and only network elements relevant to the invention will be described.

In the exemplified CDMA telecommunications system, some of the network elements are presented in terms of circuit-switched domain. However, the invention may be applied to systems, such as IP-RAN (Internet Protocol Radio Access Network), utilizing packet-switched technology.

Figure 1 shows a primary base transceiver station 102 and a secondary base transceiver station 104 for providing a primary cell 106 and a secondary cell 108, respectively, for a first user equipment 110 and a second user equipment 112 configured to operate in the cellular telecommunications network. In a third generation network, a node B is equivalent to the base transceiver station 102, 104. Sizes of the primary cell 106 and the secondary cell 108 may range from a macro-cell with an operating range of the order of kilo-

metres to a femto-cell with an operating range of the order of tens of centimetres.

In the exemplified CDMA telecommunications system, the first user equipment communicates by means of a primary cell connection 124 to the primary base transceiver station 102, thus contributing to the interference level into the primary base transceiver station 102. The second user equipment communicates by means of a secondary cell connection 122 to the secondary base transceiver station 104. A portion 126 of the radio signal associated with the secondary cell connection 122 is transferred to the primary base transceiver station 102, thus contributing to the interference level into the primary base transceiver station 102.

An entity comprising cells of different operating ranges, such as a macro-cell, a micro-cell, a nano-cell, a pico-cell, and a femto-cell, is called a hierarchical cell structure, wherein the cells of different sizes may have a partial or total overlap with each other.

The exemplified CDMA telecommunications system may further comprise a radio network controller 114 (RNC) for controlling the primary and secondary base transceiver stations 102, 104. A base transceiver station 102, 104 and the radio network controller 114 together form a radio access network (RAN). The exemplified base transceiver stations 102, 104 may share a radio network controller 114, or the base transceiver stations 102, 104 may be controlled by separate radio network controllers 114 capable of transferring information from one to another. The radio network controller 114 acts as an interface between higher layers or the CDMA telecommunications system and the radio access network. Applications may exist where a radio network controller 114 and a base transceiver station 102, 104 are integrated into a common unit.

The tasks the radio network controller 114 performs include: power control, handover control, admission control, packet scheduling, code management, and load control.

A task of the admission control is to evaluate whether a capacity request may be granted to the user equipment 110, 112 while satisfying the bearer requirements of the existing connections. An evaluation is performed by predicting the load of the cell if the capacity request is admitted.

In packet scheduling, a packet connection with burst-like traffic is managed. The burst-like traffic may have random characteristics, such as arrival time, reading time, packet sizes, and number of packets per a connection

session, which characteristics may be controlled in a packet scheduling procedure according to an interference level and a reference interference level.

The exemplified CDMA telecommunication system may further comprise a mobile switching centre (MSC) 116 connected to the radio network controller 114 enabling circuit-switched information transfer between the radio access network and higher layers of the cellular telecommunications system.

The exemplified CDMA telecommunications system may further comprise a gateway mobile services switching centre 118 (GMSC) connected to the mobile switching centre 116. The gateway mobile services switching centre 118 attends to the circuit-switched connections between the core network comprising the mobile switching centre 116 and the gateway mobile services switching 116, and external networks (EXT) 120, such as a public land mobile network (PLMN) or a public switched telephone network (PSTN).

The user equipment 110, 112 provides a user with access to the cellular telecommunication system. The user equipment 110, 112 may comprise conventional components, including wireless modems, processors with software, memory, a user interface, and a display. The user equipment 110, 112 performs radio resource management, such as power control and handover control. The structure and functions of the mobile station 110, 112 are known to a person skilled in the art, and thus will not be described in detail.

Figure 2 illustrates imaginary power control sequences of the first user equipment 110 and the second user equipment 112 in two coupling schemes separated by a horizontal dashed line. The upper portion of Figure 2 illustrates a full coupling scheme between the primary cell 106 and the secondary cell 108. The lower portion of Figure 2 shows a partial coupling scheme between the primary cell 106 and the secondary cell 108. The full coupling scheme is typical for a non-hierarchical cell structure, wherein power levels 210, 212 of the first user equipment 110 and the second user equipment 112, respectively, are approximately of the same order of magnitude. The partial coupling scheme shown in the lower portion of Figure 2 may preferably be applied to a hierarchical cell structure, wherein the size of the primary cell 106 is smaller than that of the secondary cell 108. Such a situation is realized, for example, when the primary cell 106 is a pico-cell, and the secondary cell 108 is a macro-cell. The x-axis 226 and y-axis 228 show time and power, respectively, in arbitrary units.

In the initial state of the full coupling scheme, the first user equipment 110 may be camped on the primary cell 106 and the second user equipment 112 may be camped on the secondary cell 108.

At time instant 218 (t_1), the power level 210 of the first user equipment 110 is increased, for example, due to a transition from an idle mode to an active mode.

At time instant 220 (t_2), the power level 212 of the second user equipment 112 is increased so as to compensate for the interference level increase caused by the increase in the power level 210 of the first user equipment 110, thus resulting in an increase in the interference level into the primary base transceiver station 102.

At time instant 222 (t_3), the power level 210 of the first user equipment 110 is increased as a result of interference level increase due to the increase of the power level 212 of the second user equipment 112 at time instant 220 t_2.

At time instant 224 (t_4), the power level of the second user equipment 112 is increased as a response to an increased interference level due to increase in the power level 210 of the first user equipment 110, thus resulting in a further increase in the interference level into the primary base transceiver station 102. The iteration of the imaginary power control steps may be continued with decreasing step size in the power increase.

In the initial state of the partial coupling scheme, the first user equipment 110 may be camped on the primary cell 106 and the second user equipment 112 may camped on the secondary cell 108.

At time instant 218 (t_1), the power level 216 of the second user equipment 112 is increased, for example, due to a transition from an idle mode to an active mode.

At time instant 220 (t_2), the power level 214 of the first user equipment 110 is increased in order to compensate for the interference level increase caused by the increase of the power level 216 of the second user equipment 112 at time instant 218 (t_1). However, due to the small transmit power of the first user equipment 110, the resulting increase in the interference level into the secondary base transceiver station 104 is negligible, and the power level adjustment needed for the second user equipment 112 is small. As a result, the feedback chain of successive power adjustments is interrupted, and the power levels 214, 216 of both user equipment 110 and 112 are stabi-

lized in the early stage of iteration. The final interference level into the primary base transceiver station 102 is affected by the second user equipment 112. However, the effect of the first user equipment 110 on the final interference level into the secondary base transceiver station 104 is small. In this case, the two cells 106, 108 are deemed to be partially coupled.

Adjustments in the power levels 210, 212, 214, 216 may be based on, for example, uplink link budgets of the user equipment 110, 112. An increase in the interference level results in a decrease in the link budget, which is compensated by increasing the transmitting power level 210, 212, 214, 216.

The example of the imaginary power adjustment chains in the partially coupled scheme shown in Figure 2 suggests that the interference experienced by the primary base transceiver station 102 may be divided into a cell-load-dependent portion and a cell-load-independent portion. The cell-load independent portion arises from the secondary cell connections, i.e. uplink connections of a plurality of second user equipment 112 to the at least one secondary cell 108.

Figure 3 illustrates an interference level 310 into the primary base transceiver station 102 and a reference interference level 312B. A priori reference interference level 312A, such as a background noise level, is also shown. The a priori reference interference level 312A may have a predetermined value set by, for example, a network planner. The a priori reference interference level 312A may be tuned using a separate algorithm after the a priori interference level has been initialised by the network planner. The y-axis 314 shows a value of interference in an arbitrary unit. The y-axis quantity may also be called an interference margin, an interference increase, or a noise rise. The x-axis 316 shows a cell load in an arbitrary unit. The interference level 310 may be expressed by means of formula

$$I = I_{REF} + I_{PRIM} + I_{SEC}, \qquad (1)$$

where I is the interference level 310, I_{REF} is the reference interference level 312B, I_{PRIM} is a contribution of the primary cell connections 124 to the interference level 310, and I_{SEC} is a contribution of the secondary cell connections 122 to the interference level 310.

Figure 3 further shows a load curve 318 representing an example of a characterising curve, which characterizes the relation between the interference level 310 and a cell characteristic, such as a cell load.

In an embodiment, the characterising curve may be expressed with load curve equation

$$I = 10 \times Log\left(\frac{1}{1 - L_{UL}}\right) + \text{f}, \tag{2}$$

wherein I represents a rise in the interference level in arbitrary units, L_{UL} represents an uplink cell load as a percentage of a full load, and f is a shift factor representing the coupling between the cells 106, 108.

In an embodiment, the uplink cell load L_{UL} may be expressed with load equation

$$\mathrm{L_{UL}} = \sum_{k=1}^{N} \alpha_k \times \frac{(E_b / No)_k}{PG_k} \times [1 + i_c], \tag{3}$$

wherein α_k is the activity factor of connection k, E_b is energy per user bit, No_k is a noise spectral density, PG_k is the processing gain for connection k, i_c is the intercell interference ratio accounting for cell coupling and N is the number of active connections.

The interference level 310 may be, for example, a total uplink interference power into the primary base transceiver station 102. The reference interference level 312B represents an interference level, which is independent of the cell load of the primary cell 106.

Figure 4 shows an example of a primary base transceiver station 102, a network controller 410, and an arrangement 406 for managing uplink radio resources in a CDMA telecommunications system. The exemplified primary base transceiver station 102 includes an antenna unit 405 for converting an uplink radio signal 122, 124, 126 into a radio frequency electric signal, which is transferred into the radio frequency part 404 (RF). The radio frequency part 404 converts the radio frequency electric signal into a base band frequency digital signal, which is received by a base band part 402 (BB). The base band part 402 performs signal processing on the base band frequency digital signal. For example, power measurements on a received signal 124, 126 and a resulting interference level determination are carried out in the base band part 402. A control unit 408 controls the base band part 402 and the radio frequency part 404. In the presented example, the interference level information is delivered from the base band part 402 to the control unit 408, which signals the interference level information 409 to the radio network controller 410 by using a separate signalling channel. The interference level information may be reported to the radio network controller 410 periodically, and the period

may be adjusted according to a repetition rate of the presented method. A structure and function of a CDMA base transceiver station is known to a person skilled in the art and only relevant parts will be described.

The interference level information 409 is delivered from the base transceiver station 102 to means 412, which determines a contribution of secondary cell connections 122 to the interference level 310. The contribution of the secondary cell connections 122 to the interference level 310 may be obtained from equation (1) by solving I_{SEC}. The means 412 may be located in the radio network controller 114, 410 and implemented with a computer and software.

In an embodiment of the invention, the arrangement further comprises means 428 for determining a contribution of primary cell connections 124 to the interference level 310 and means 430 for determining the contribution of the secondary cell connections 122 to the interference level 310 by using the interference level 310 and the contribution of the primary cell connections 124 to the interference level 310.

Interference level information 409 is delivered from the base transceiver station 102 to the means 428. The contribution of the primary cell connections 124 to the cell load may be estimated, for example, by using SIR (Signal-to-Interference) targets for the primary cell connections 124, which SIR targets are transformed into $(E_b/No)_k$ figures for each primary cell connection 124. The SIR targets may be delivered to the means 428 using, for example, an outer loop power control. The bit rate of each primary connection 124 is known, thus enabling to solve processing gain PG_k for each primary cell connection k. As a result, a quantity $C_k = I + (E_b/No)_k - PG_k)$ may be solved, wherein C_k represents a total received power from a primary cell connection k in logarithm units. The contribution of plurality of the primary cell connections 124 to the interference level 310 may be obtained by summing the C_k over the primary cell connections 124. The means 428 may be located in the radio network controller 114, 410 and implemented with a computer and software.

The contribution of the secondary cell connections 122 to the interference level 310 may be obtained from equation (1) by solving $I_{SEC} = I - I_{REF} - I_{PRIM}$. The means 430 may be located in the radio network controller 114, 410 and implemented with a computer and software.

The contribution of the secondary cell connections 122 to the interference level 310 is delivered from means 412, 430 to the means 414, which

compute a proportionality factor for adjusting the reference interference level 312B relative to the interference level 310. The proportionality factor is proportional to the contribution of the secondary cell connections 122 to the interference level 310, which contribution is determined by the means 430. The proportionality factor defines a gap 336 between the interference level 310 and the reference interference level 312B. The proportionality factor may also define a gap between the a priori reference interference level 312A, such as background noise, and the interference level 310, provided that the interference level 310 and the a priori reference interference level 312A are represented in the same scale.

In an embodiment of the invention, the arrangement comprises means 418 for computing a proportionality factor proportional to a coupling between the primary cell 106 and the at least one secondary cell 108. The proportionality factor P may be expressed as,

$$P=F*I_{SEC}, \tag{4}$$

where F is a coupling factor representing a coupling between the primary cell 106 and the secondary cell 108. The coupling factor may range, for example, from 0 to 1, where F=0 corresponds to a full coupling case, and F=1 a case where there is no coupling between the cells 106, 108. The value of the coupling factor may be fixed to a certain value based on cell measurements. The means 418 may be located in the radio network controller 114, 410 and implemented with a computer and software.

The proportionality factor and the reference interference level 310 are delivered to means 416, which adjust the reference interference level 312B relative to the interference level 310 by using the proportionality factor.

In an embodiment of the invention, the arrangement comprises means 432 for adjusting the reference interference level 312B by shifting the reference interference level 312B relative to the interference level 310 by the amount of the proportionality factor. The shift corresponds to the gap 338 between the reference interference level 312B and the a priori reference interference level 312A. In this case, the reference interference level 312B may be written as

$$I_{REF}=I_{AP}+ P, \tag{5}$$

where I_{AP} is the a priori reference interference level 312A and P is the proportionality factor, such as that given in Equation (4). The means 418 and 432

may be located in the radio network controller 114, 410 and implemented with a computer and software.

In an embodiment of the invention, the arrangement comprises means 422 for basing a characterising curve 318, which characterises the relation between a cell characteristic and an interference level 310, on the reference interference level 312B. By adjusting the reference interference level 312B, the characterising curve 318 is shifted relative to the interference level 310. As a result, an operating point 340 defined by the characterising curve 318 and the interference level 310 is shifted in x-direction.

The effect of adjusting the reference interference level 312B on the characterising curve may be expressed in terms of shift factor f given in Equation 2. When relating the reference interference level 312B to the a priori reference interference level 312A, such as a background noise level, the shift factor characterises the gap 338 between the background noise and the reference interference level 312B. The means 422 may be located in the radio network controller 114, 410 and implemented with a computer and software.

In an embodiment of the invention, the arrangement comprises means 420 for controlling the uplink radio resources based on the interference level 310 and the reference interference level 312B. The interference level 310 and the reference interference level 312B are delivered from the means 416 to means 420. It is also possible that the information on the characterising curve 318 is delivered from means 422 to means 420, which performs the control tasks accordingly.

An example of a control task includes determining an operating point 340 on the characterising curve 318. Then, a change 330 in load estimated based on, for example, a change in capacity request. The change 330 in load is added to the load 322 corresponding to the operating point 340, thus yielding a new load value 324. A change in the interference 332 is obtained by means of the new load value 324, and admission control and/or scheduling is performed accordingly.

The effect of adjusting the interference level 312B is shown in Figure 3. The load curve 320 corresponds to a situation wherein there is no adjustment of the reference interference level 312B, and the load curve 320 is based on the background noise level 312A. This corresponds to a full coupling scheme. In this case, the cell load 326 corresponding to the operating point 342 is higher, and the change 330 in the cell load and thus a new load value

328 lead to a larger change 334 in the interference level than in the partial coupling scheme. The larger change 334 in the interference level results in pessimistic estimation of the interference level and waste of radio resources.

In an embodiment of the invention, the arrangement further comprises means 434 for providing time control for the arrangement and the method. The time control includes a repetition rate and duration of the repetition sequence applied to embodiments of the invention. A repetition rate may be adjusted by the network planner and the method may be repeated 20 time a second, for example. The duration of the repetition sequence may vary from 100 ms to tens of seconds. The means 434 may be located in the radio network controller 114, 410 and implemented with a computer and software.

With reference to Figure 5, the methodology used by the arrangement according to embodiments of the invention is shown. In 500, the method starts. In 502, the interference level 310 into the primary base transceiver station 102 is determined. In 504, a contribution of primary cell connections 124 to the interference level 310 is determined. In 506, a contribution of the secondary cell connections 122 to the interference level 310 is determined. In 508, a proportionality factor for adjusting the reference interference level 312 relative to the interference level 310 is computed. In 510, the reference interference level 312 relative to the interference level 310 is adjusted by using the proportionality factor. In 512, a characterising curve 318 is based on the reference interference level 312. In 514, uplink radio resources are controlled based on the interference level 310 and the reference interference level 312. In 516, the method is repeated. In 518, the method is stopped.

Even though the invention is described above with reference to an example according to the accompanying drawings, it is clear that the invention is not restricted thereto but it can be modified in several ways within the scope of the appended claims.

Claims

1. A method of managing uplink radio resources in a CDMA telecommunications system comprising a primary base transceiver station for providing a primary cell and at least one secondary base transceiver station for providing at least one secondary cell, the method comprising:

determining (502) an interference level into the primary base transceiver station,

c h a r a c t e r i z e d by

determining (506) a contribution of secondary cell connections to the interference level;

computing (508) a proportionality factor for adjusting a reference interference level relative to the interference level, the proportionality factor being proportional to the contribution of the secondary cell connections to the interference level; and

adjusting (510) the reference interference level relative to the interference level by using the proportionality factor.

2. The method of claim 1, c h a r a c t e r i z e d by computing (508) a proportionality factor proportional to a coupling between the primary cell and the at least one secondary cell.

3. The method of claim 1, c h a r a c t e r i z e d by controlling (514) the uplink radio resources based on the interference level and the reference interference level.

4. The method of claim 1, c h a r a c t e r i z e d by basing (512) a characterising curve, which characterises relation between a cell characteristic and an interference level, on the reference interference level.

5. The method of claim 1, c h a r a c t e r i z e d by determining (504) a contribution of primary cell connections to the interference level; and

determining (506) the contribution of the secondary cell connections to the interference level by using the interference level and the contribution of the primary cell connections to the interference level.

6. The method of claim 1, c h a r a c t e r i z e d by adjusting (510) the reference interference level by shifting the reference interference level relative to the interference level by the amount of the proportionality factor.

7. The method of claim 1, c h a r a c t e r i z e d by repeating (516) the method for a predetermined period of time.

8. The method of claim 1, characterized by repeating (516) the method at a predetermined rate.

9. An arrangement for managing uplink radio resources in a CDMA telecommunications system comprising a primary base transceiver station (102) for providing a primary cell (106) and at least one secondary base transceiver station (104) for providing at least one secondary cell (108), the arrangement comprising:

means (402) for determining an interference level (310) into the primary base transceiver station (102),

characterized in that the arrangement further comprises:

means (412) for determining a contribution of secondary cell connections (122) to the interference level (310);

means (414) for computing a proportionality factor for adjusting a reference interference level (312B) relative to the interference level (310), the proportionality factor being proportional to the contribution of the secondary cell connections (122) to the interference level (310); and

means (416) for adjusting the reference interference level (312B) relative to the interference level (310) by using the proportionality factor.

10. The arrangement of claim 9, characterized in that the arrangement further comprises means (418) for computing a proportionality factor proportional to a coupling between the primary cell (106) and the at least one secondary cell (108).

11. The arrangement of claim 9, characterized in that the arrangement further comprises means (420) for controlling the uplink radio resources based on the interference level (310) and the reference interference level (312B).

12. The arrangement of claim 9, characterized in that the arrangement further comprises means (422) for basing a characterising curve (318), which characterises relation between a cell characteristic and an interference level (310), on the reference interference level (312B).

13. The arrangement of claim 9, characterized in that the arrangement further comprises:

means (428) for determining a contribution of primary cell connections (124) to the interference level (310); and

means (430) for determining the contribution of the secondary cell connections (122) to the interference level (310) by using the interf rence level

(310) and the contribution of the primary cell connections (124) to the interference l vel (310).

14. The arrangement of claim 9, characterized in that the arrangement further comprises means (432) for adjusting the reference interference level (312B) by shifting the reference interference level (312B) relative to the interference level (310) by the amount of the proportionality factor.

15. The arrangement of claim 9, characterized in that the arrangement further comprises means (434) for providing time control for the arrangement.

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(57) Abstract

A method and an arrangement for managing uplink radio resources in a CDMA telecommunications systems are provided. The arrangement comprises: means (402) for determining an interference level (310) into the primary base transceiver station (102), means (412) for determining a contribution of secondary cell connections (122) to the interference level (310); means (414) for computing a proportionality factor for adjusting a reference interference level (312B) relative to the interference level (310), the proportionality factor being proportional to the contribution of the secondary cell connections (122) to the interference level (310); and means (416) for adjusting the reference interference level (312B) relative to the interference level (310) by using the proportionality factor. Embodiments of the invention provide increased accuracy in a radio resource control of a CDMA telecommunications system.

(Figure 4)

1/3

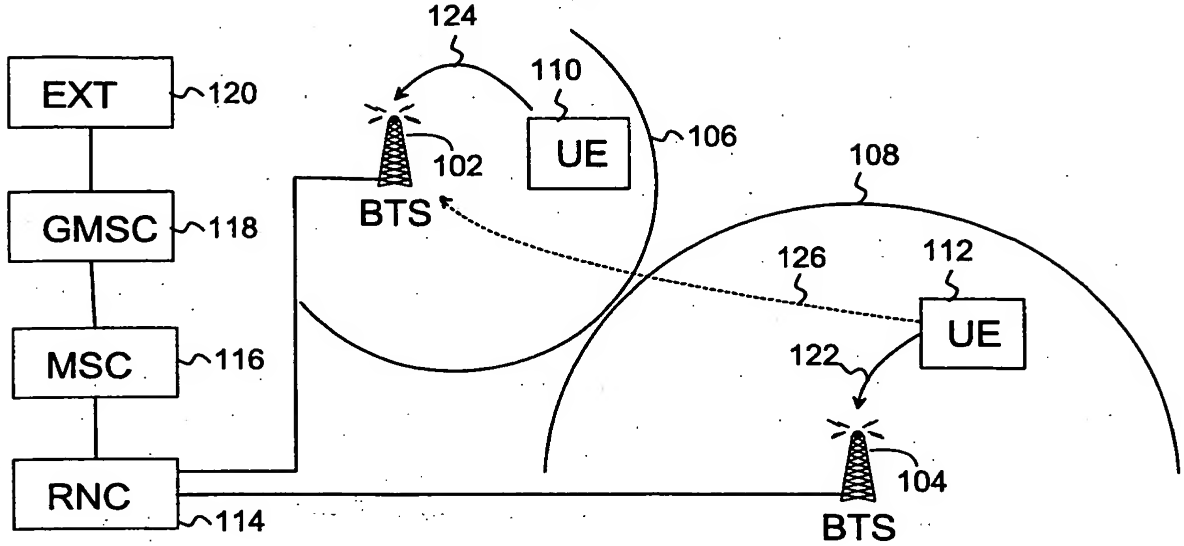
EXT
120
GMSC
118
MSC
116
RNC
114
124
110
UE
106
102
BTS
108
126
112
UE
122
104
BTS

Fig. 1

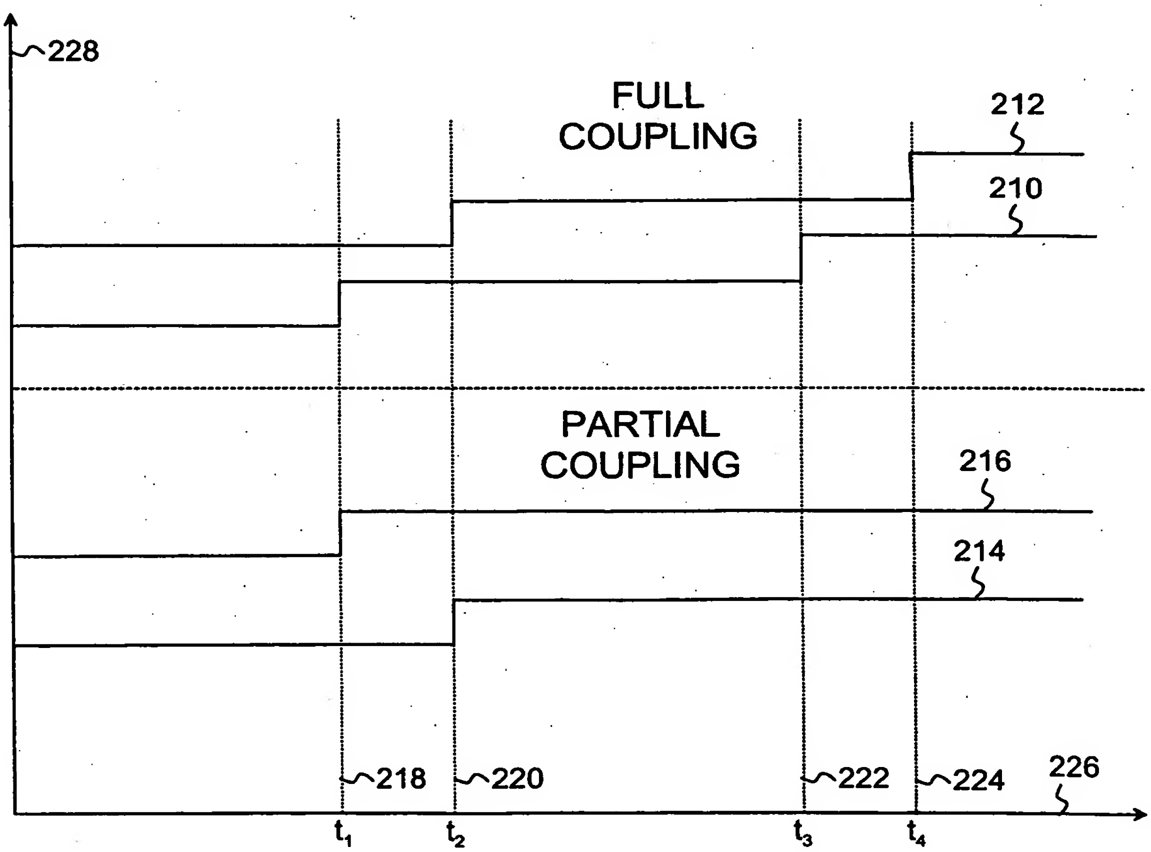
228
FULL
COUPLING
212
210
PARTIAL
COUPLING
216
214
218
220
222
224
226
t1
t2
t3
t4

Fig. 2

2/5

2/3

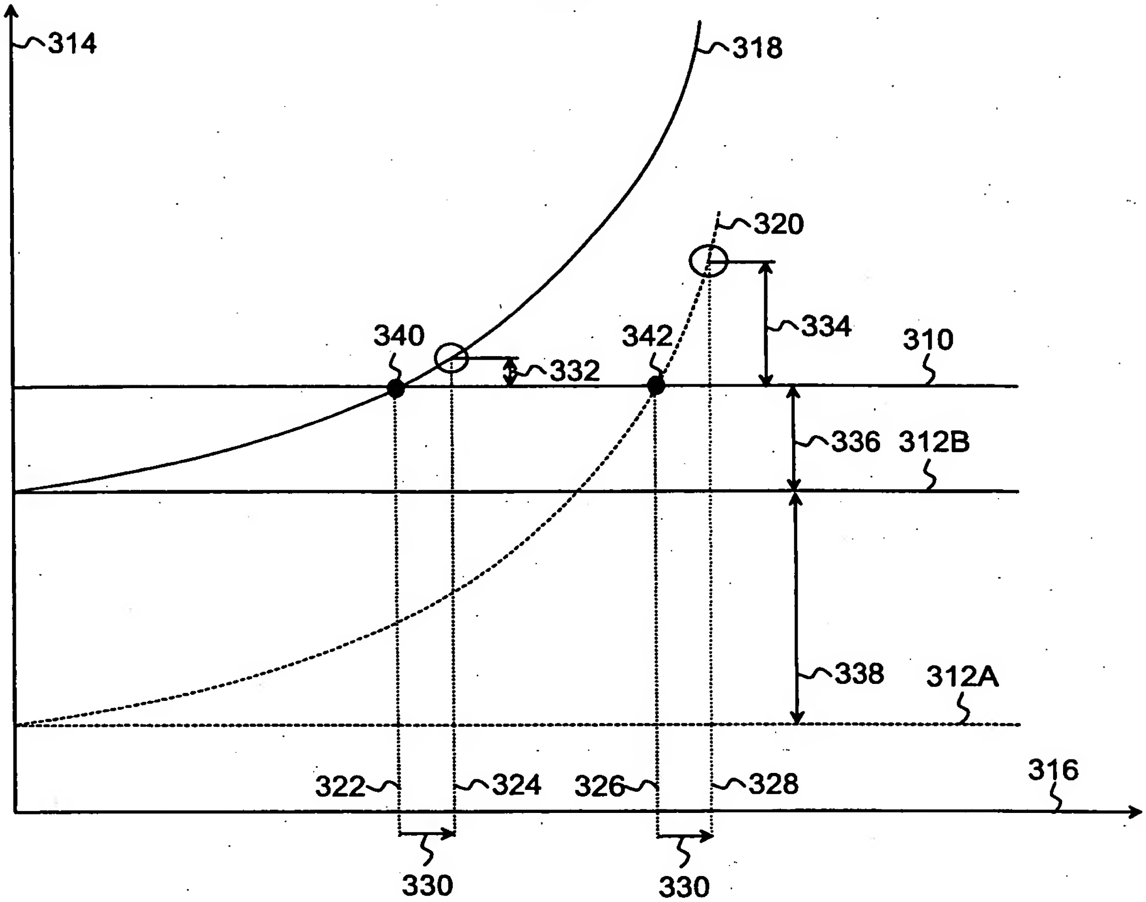

Fig. 3

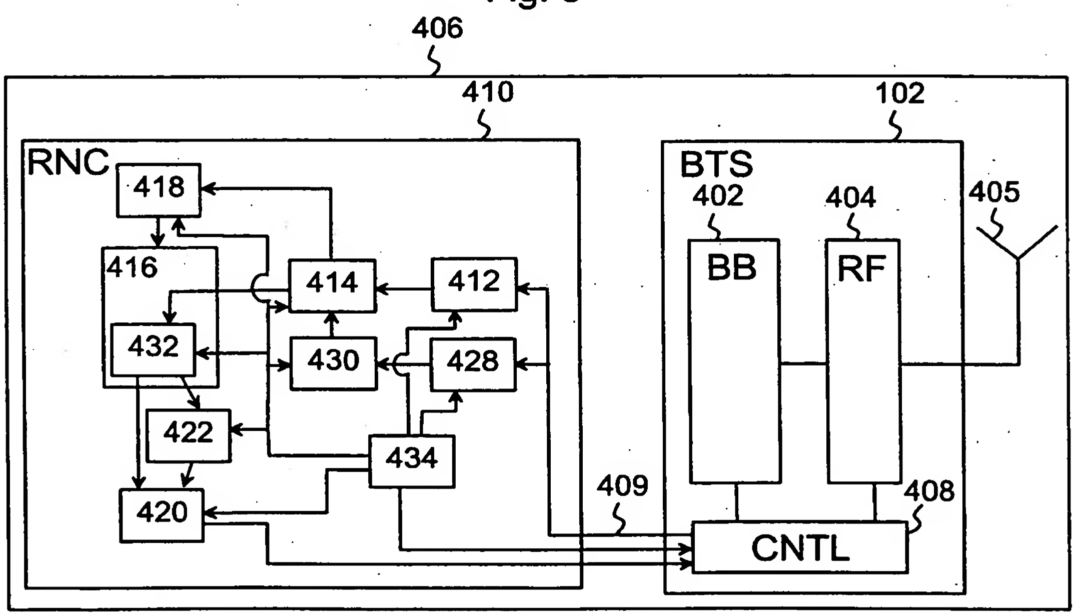

Fig. 4

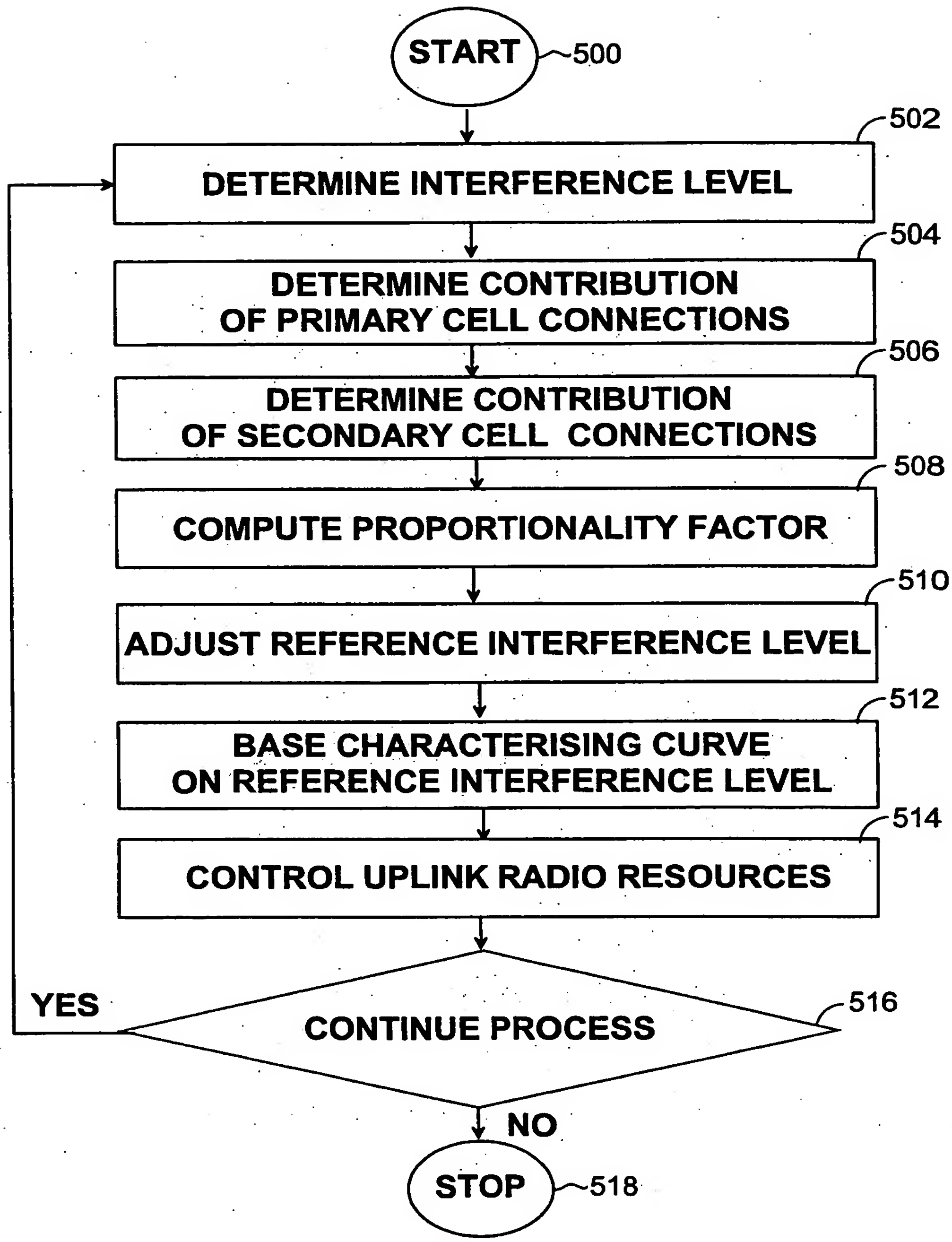
START
500
DETERMINE INTERFERENCE LEVEL
502
DETERMINE CONTRIBUTION OF PRIMARY CELL CONNECTIONS
504
DETERMINE CONTRIBUTION OF SECONDARY CELL CONNECTIONS
506
COMPUTE PROPORTIONALITY FACTOR
508
ADJUST REFERENCE INTERFERENCE LEVEL
510
BASE CHARACTERISING CURVE ON REFERENCE INTERFERENCE LEVEL
512
CONTROL UPLINK RADIO RESOURCES
514
YES
CONTINUE PROCESS
516
NO
STOP
518

Fig. 5